# *Sensors and Accessories*

## *Appendix to hardware manuals for*

### *FlexComp Infiniti, ProComp Infiniti, ProComp5 Infiniti and ProComp2*


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# Introduction

The instrumentation system includes a group of sensors and accessories used for the various protocols. This manual describes all the sensors and the accessories that you may have with your system. Note that more detailed information may be found in other manuals, such as Suite manuals, clinical guides or sensor/accessory manual.

## Electromagnetic interferences

The SEMG and EKG sensors are capable of detecting very tiny electrical signals (millionths of a Volt) generated by muscle activity. Therefore they are very sensitive to electromagnetic fields generated by other devices in the exam room, such as radio transmitting devices, computer monitors, medical devices (for example x-ray machines), and fluorescent, halogen or neon lights.

These devices should be turned off, if they are not needed for the examination. If the situation arises, keep the instrumentation 10 feet away from radio transmitting devices and 3 feet away from electronic devices (including monitors) and fluorescent, halogen or neon lights.

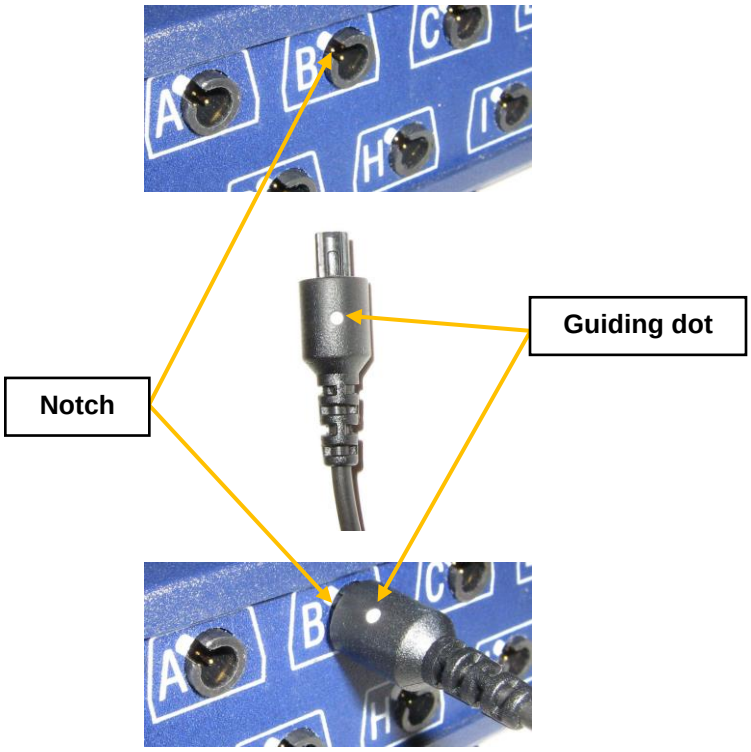
Disconnect all the unused sensors from the encoder. If not connected to the examinee, they may act as antennas and capture unwanted signals that would corrupt the signal.

## Electrostatic discharges

To prevent static discharge from damaging the sensor and/or encoder, use anti-static mats or sprays in your working area. A humidifier may also be used to help prevent static environments by conditioning hot, dry air.

## Connecting the sensors

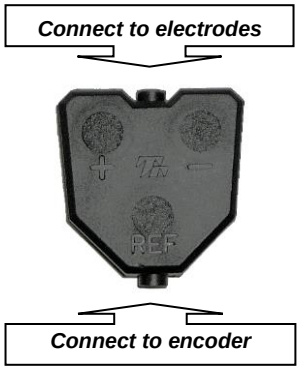
When connecting a sensor to the encoder, make sure to properly line up the guiding dot on the top of the plug with the notch in the device's input socket.




Forcing the plug into the jack in any other position may damage your equipment.

## Correct orientation of sensors

For some sensors, such as the temperature and skin conductance sensors, either the connection cable or the electrode cable forms a permanent part of the item. Other sensors, for example the push button switch, have removable cables but only a single input entrance. This makes it impossible to connect these sensors in the wrong orientation to the encoder.




Certain sensors, however, have removable cables and two input entrances. It is important to orient these sensors to the encoder correctly so that the physiological signal is properly received. These sensors include the EKG, EEG, and EMG sensors, all of which are shaped like the illustration at the right.

Such a sensor is correctly oriented to the encoder when the cable joining them is connected to the bottom entrance of the sensor. If an extender cable with electrodes needs to be attached to such a sensor, it should be connected to the top entrance of the sensor.

# Sensors List

This is an overview of the sensors, electrodes, and accessories used with the system.

## ELECTROENCEPHALOGRAPHY (EEG): EEG-Z Sensor (P/N: SA9305Z) and EEG-Z3 Sensor (SA7680)

### EEG-Z Sensor (P/N: SA9305Z)

EEG-Z is a pre-amplified electroencephalograph sensor with built in impedance checking. This sensor can be toggled to record regular EEG or monitor skin impedance (both the reactive and resistive elements) to help optimize electrode hook-up.

Each EEG-Z sensor comes with a monopolar/bipolar electrode kit (shown).

Other electrode kits are also available (for example, 2-channel, linked ear).

**Monopolar/bipolar electrode kit (T8750)**

#### Operating Principle

The EEG sensor detects and amplifies the small electrical voltages that are generated by brain cells (neurons) when they fire. Similarly to muscle fibers, neurons of different locations can fire at different rates. The frequencies most commonly looked at, for EEG, are between 1 and 40 Hz. The EEG sensor records a “raw” EEG signal, which is the constantly varying difference of potential between the positive and negative electrode, and the software processes that signal by applying a variety of digital filters to the recorded signal, in order to extract frequency-domain information.

***Note**: EEG practitioners call the negative electrode "reference" and the positive electrode "signal".*

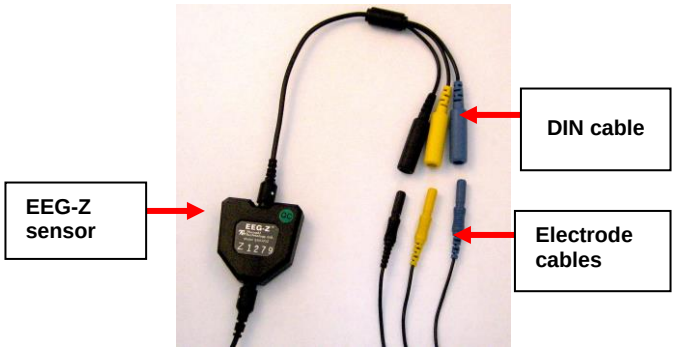
#### Sensor Placement

Instructions for 1-channel EEG:

Connect the blue active electrode to the blue DIN cable input.

Connect the yellow ear clip to the yellow DIN cable input, and the black earclip to the black DIN cable input.

The other end of the DIN cable plugs into the input of the EEG-Z sensor.



## EEG-Z3 Sensor (P/N: SA7680)


The EEG-Z3 is a pre-amplified electroencephalograph sensor. It can be used on its own for EEG neurofeedback or in combination with the TT-AV Sync sensor (T7670) and a push-button switch (SA7660). When combined, these sensors comprise a system designed for evoked and slow cortical potentials, and reaction time protocols.

The EEG-Z3 can be used in any of the following three modes. All three modes support impedance checking.

- Standard mode for regular EEG, similar to the EEG-Z sensor.
- EP/0.01 Hz (0.01 Hz frequency cutoff) for evoked, event-related potentials and slow cortical potentials.
- SCP/DC mode for measuring slow cortical potentials.

A Set/Zero button allows quick switching between modes. LED indicators identify the active mode. When it is powered off, the sensor "remembers" the mode in which it was last used.

In all three modes, if the signal approaches or passes the limit of the range that the sensor can measure, the LED will blink rapidly. This is useful in SCP/DC mode, in which the Set/Zero button can be used to return the signal to baseline.

For more information, read the EEG-Z3 manual.

### Sensor components

- EEG-Z3 sensor
- Zeroing cable
- Sensor cable (SA9385M). For connection of EEG-Z3 sensor to encoder.
- EEG Electrodes

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***Note:*** *In EP/0.01 and SCP/DC modes, always use sintered Silver/Silver Chloride (Ag/AgCl) electrodes with proper skin preparation and application to reduce DC drift.*

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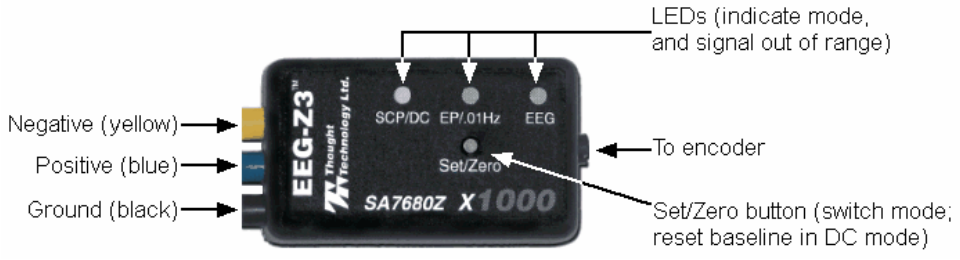
### Connecting the sensor



### *Software zeroing*

Prior to the first use, the EEG-Z3 sensor may be zeroed using the sensor calibration function of BioGraph Infiniti and the zeroing cable provided (shown right).

### *Mode selection*

Press and hold the Set/Zero button to cycle through the three modes. Release to select desired mode.

### *Baseline reset*

In SCP/DC mode, when the LED blinks to indicate that the signal is approaching the limits of the sensor's range, press Set/Zero button once to reset the signal to baseline. To select a different baseline than the middle of the range, double click the Set/Zero button.

### Impedance Checking

Good preparation of the skin for contact is necessary for accurate results and prevention of artifacts. Measuring the impedance between the electrodes is the recommended way to verify good contact.

When one or more EEG-Z/EEG-Z3 sensors are plugged into the encoder, it is possible to invoke the sensors' impedance checking function. To do this, press and hold the power button for approximately 3 seconds, or until you see the blue LED blink quickly 2 times. Then release the power button.

In this mode, any EEG-Z/EEG-Z3 sensors that are plugged into the encoder are commanded one after the other to perform an impedance check. The results may be read from the BioGraph Infiniti software to which the encoder is connected. The impedance checking continues, in round-robin order, as long as the mode is selected. It takes about 1 second to check impedance on each sensor, and the total time to complete the entire set of sensors depends on the number plugged into the encoder.

EEG readings from the encoder are not valid while impedance checking is occurring, and any traces will be replaced by signals used in the impedance check process.

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***Attention***

*A set of Z sensors (*EEG-Z/EEG-Z3*and/or MyoScan-Z)* **all connected to the same encoder** *will not interfere with each other's impedance check readings, as they are commanded to perform their impedance checks sequentially, and are designed to disconnect from the client while not checking impedance. However, sensor types other than* EEG-Z/EEG-Z3 *or MyoScan-Z that are electrically connected to the client can potentially affect the impedance readings obtained from Z sensors.*

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If possible, leave other electrically connected sensors (such as EKG, SC) unconnected during impedance checking, or else perform a test to see whether their connection causes a significant change in the reading.

Sensors (even Z sensors) attached to the same client but connected to *another encoder* also have the potential to affect Z sensors readings. In particular, do not attempt to perform impedance checking on two encoders on a single client, at the same time. Here again, test for the effect of other connected sensors if you are concerned about receiving precise impedance readings.

**10–20 electrode placement system**

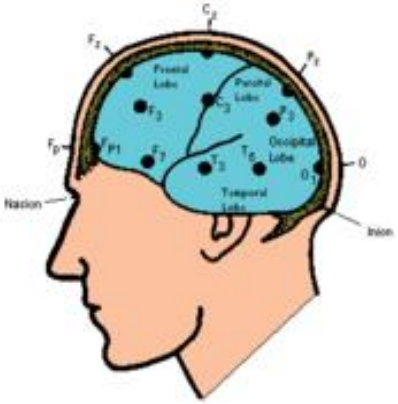
The ten–twenty (10–20) electrode system of the International Federation is the standard for electrode placement. It is used to place surface EEG electrodes in a repeatable way independent of inter-patient anatomical variability. Called 10–20 because of the way distances between electrode sites are computed. The distances between certain anatomical landmarks are segmented at increments of 10% and 20% of their value, and electrodes are placed at these points.

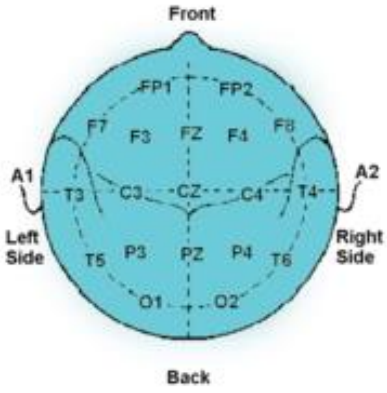
A letter is used to indicate over which area of the brain the site is located. Sites are identified as follows:

| | | |
|---|---|---|
| Frontal lobe – F | Central sulcus – C | Parietal lobe – P |
| Frontopolar area – FP | Temporal lobe – T | Occipital lobe – O |

Other miscellaneous labels are used for the ears (A) and other reference sites (for example, M for mastoid process, G for ground, etc.). The letter Z indicates the central line along the interhemispheric fissure.

Numbers are used to indicate the position in reference to the central line (Z). Number value increases the further away a site is from the central line. Odd numbers are on the left. Even numbers are on the right




For example, along the line joining sites A1 and A2: to the right of A1, at 10% of the overall A1–A2 distance is electrode site T3. This is followed by C3 (20% further), Cz (20% further), C4 (20% further), and T4 (20% further). Site T4 should fall 10% to the left of A2.

## ELECTROMYOGRAPHY (EMG): MyoScan (P/N: SA9503M), MyoScan-Z (P/N: SA9503Z) and MyoScan-Pro (P/N: SA9401M-60 or SA9401M-50)


MyoScan and MyoScan Z are pre-amplified surface electromyography sensors, sensing raw SEMG.

MyoScan-Z also allows impedance check.

- Input Range 0 -2000 µV
- Bandwidth 10 Hz – 500Hz.

MyoScan and MyoScan-Z sensors require a sampling rate of 2048 samples/second (s/s). Therefore, they are used on channels A and B of ProComp Infiniti and ProComp5 Infiniti and all channels of FlexComp Infiniti. **They cannot be used with the ProComp2**.

**MyoScan/MyoScan-Z**


**MyoScan-Pro**

The MyoScan-Pro has built-in electronic circuitry to perform a root mean square (RMS) computation on the EMG signal, directly inside the sensor. The resulting RMS signal has a much slower rate of change and can be sampled at lower frequencies, including the 32 s/s available on the ProComp2. Therefore MyoScan-Pro is used on channels C to H of ProComp Infiniti, on channels C to E of ProComp5 Infiniti, and on channels C and D of ProComp2.

The MyoScan-Pro sensor's active range is from 20 to 500 Hz. It can record SEMG signals of up to 1600 micro-volts (μV), RMS. On the back of the sensor, there is a small switch with three positions: 400N, 1600W and 400W. In the 400W (wide bandwidth) position, the sensor will be sensitive to the full 20-500Hz bandwidth. When recording SEMG from the upper body muscles, the sensor might pick up some electrical interference from the heart muscle, which is usually seen as a sharp spike occurring at every heartbeat.

This noise can be filtered out by moving the switch to the 400N (narrow bandwidth) position. In this position, the sensor will only be sensitive to frequencies between 100 and 200 Hz. The third position, 1600W is for monitoring large muscle groups like thigh muscles. At the 400W or 400N positions, the sensor's amplitude scale is 400 μV, which allows for a good resolution for most of the body's muscles. The larger body muscles can produce microvolt readings of up-to 1600 μV. To properly monitor their activity, set the sensor to the 1600W position.

**Operating Principle**

EMG measures muscle activity by detecting and amplifying the tiny electrical impulses that are generated by muscle fibers when they contract. Since all the muscle fibers within the recording area of the sensor contract at different rates, the signal detected by the sensor is a constantly varying difference of potential between its positive and negative electrodes. The number of muscle fibers that are recruited during any given contraction depends on the force required to perform the movement. Because of this, the intensity (amplitude) of the resulting electrical signal is proportional to the strength of contraction.

**Sensor Placement**

***Skin Preparation***


Proper skin preparation is important to get a good signal and avoid artifacts.

Before applying electrodes, make sure the skin surface is clean and dry:

Abrade the skin with an abrasive cream, such as NuPrep, to remove dead skin. Alternatively, you can also clean skin with an alcohol wipe and let it dry, but this is not as efficient as the abrasive cream. If necessary, shave excess body hair.

***General Recommendations for Positioning Electrodes and Cables***

The electrodes are either directly connected to (or “snapped on”) the sensor, or indirectly connected via an extender cable.

If you use single electrodes with an extender cable, start by snapping the electrodes on the cable connectors. Once the electrodes are positioned on the skin, this action may be more difficult or uncomfortable for the client.


It may be recommended to put conductive electrode paste or cream (such as Ten20) on the center of electrodes (grey area only) before applying them to the skin. Only a small amount is necessary.

Place the active electrodes first (blue and yellow) on the examinee. The active electrodes should be placed in line with the muscle fibers, unless specified otherwise. Then place the reference electrode (black connector) anywhere on the body.

Make sure the electrodes are placed firmly on the skin and that there is good contact between the skin and electrodes.

**Impedance Checking (MyoScan-Z only)**

Good preparation of the skin for contact is necessary for accurate results and prevention of artifacts. Measuring the impedance between the electrodes is the recommended way to verify good contact.

When one or more MyoScan-Z sensors are plugged into the encoder, it is possible to invoke the sensors’ impedance checking function. To do this, press and hold the power button for approximately 3 seconds, or until you see the blue LED blink quickly 2 times. Then release the power button.

In this mode, any MyoScan-Z sensors that are plugged into the encoder are commanded one after the other to perform an impedance check. The results may be read from the BioGraph Infiniti software to which the encoder is connected. The impedance checking continues, in round-robin order, as long as the mode is selected. It takes about 1 second to check impedance on each sensor, and the total time to complete the entire set of sensors depends on the number plugged into the encoder.

EMG readings from the encoder are not valid while impedance checking is occurring, and any traces will be replaced by signals used in the impedance check process.

***Attention***
*A set of Z sensors (EEG-Z/EEG-Z3 and/or MyoScan-Z)* **all connected to the same encoder** *will not interfere with each other’s impedance check readings, as they are commanded to perform their impedance checks sequentially, and are designed to disconnect from the client while not checking impedance. However, sensor types other than EEG-Z/EEG-Z3 or MyoScan-Z that are electrically connected to the client can potentially affect the impedance readings obtained from Z sensors.*

If possible, leave other electrically connected sensors (such as EKG, SC) unconnected during impedance checking, or else perform a test to see whether their connection causes a significant change in the reading.

Sensors (even Z sensors) attached to the same client but connected to *another encoder* also have the potential to affect Z sensors readings. In particular, do not attempt to perform impedance checking on two encoders on a single client, at the same time. Here again, test for the effect of other connected sensors if you are concerned about receiving precise impedance readings.

**Zeroing (MyoScan-Pro only)**

Since the MyoScan-Pro uses internal electronic circuitry to perform RMS rectification from within the sensor, it is sometimes possible to observe slight offsets in sensor reading. This is particularly obvious with older sensors and at low EMG values (less than 5μV). For that reason, it will occasionally be necessary to zero your MyoScan-Pro sensors. Zeroing is done by connecting a zeroing cable to the sensor box while recording (plug it where the extender cable connects).

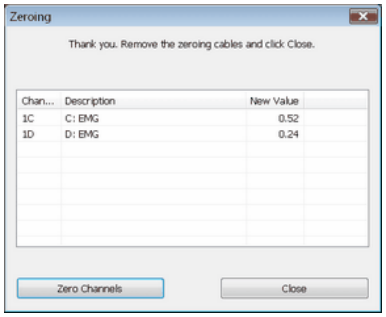
With the zeroing cable on the sensor, the reading should be zero.

If your software displays a different value, usually plus or minus a few microvolts, then you should be able to correct this offset, from within the software, by using a zeroing function.


***Zeroing with BioGraph Infiniti software:***

In the BioGraph Infiniti recording screen, do the following:

1. From the **Hardware** menu, select **Zeroing**.
2. When the **Zeroing** window opens, connect zeroing cables to the listed EMG sensors.
3. Click **Zero Channels**.
4. When the **New Values** have been calculated, click **Close** to save the values to the channel set.




Keep in mind that each sensor may have different offset values. If you zero a particular MyoScan-Pro on a given display screen, then you must always connect the same sensor to the same encoder input when you use that screen. **Remember to remove the zeroing plug after adjusting the MyoScan-Pro sensor's offset.**

## ELECTROCARDIOGRAPHY (ECG/EKG): EKG Sensor (P/N: SA9306M) and EKG Receiver for Polar (P/N: SA9330)

### EKG Sensor (P/N: SA9306M)

The EKG sensor is a pre-amplified electrocardiograph sensor, for directly measuring the heart's electrical activity.

The actual EKG signal is measured in micro-volts (µV). Most often, though, the clinically useful measures are those that are computed from the raw EKG: the heart rate (HR) and its inverse, the inter-beat interval (IBI). HR is measured in beats per minute (B/min or Bm) and IBI, in milliseconds (ms).

Although EKG signals can be sampled at 256 samples per second, it is generally recommended to use a higher sampling rate (2048) because this allows for a higher precision in the detection of heartbeats. The EKG sensor can both be used on channel B of the ProComp 2 but not on channels A, C or D. They can be used on all channels of the ProComp 5 Infiniti and ProComp Infiniti encoders but channels A and B are preferred because they allow a higher sampling rate. They can be used on all channels of the FlexComp Infiniti.

#### Operating Principle

EKG is similar to EMG: The sensor detects and amplifies the small electrical voltage that is generated by the heart muscle when it contracts.

#### Sensor Placement

Although it is possible to use the EKG sensor with dry electrodes and no skin preparation, this setup raises the probability of artifacts distorting the signal and causing calculation errors. As a general rule, skin preparation enhances the signal quality, reduces the probability of artifacts and minimizes the need for post-recording artifact rejection.

##### *Skin Preparation*


For any recording where signal quality matters, good skin preparation is important to get a clean signal and avoid artifacts. Before applying the EKG electrodes, make sure the skin surface is clean and dry by rubbing it with an alcohol pad. Abrading the skin with an abrasive cream, such as NuPrep, can also help. If necessary, shaving excess body hair can be required.

##### *Selecting the Electrodes*

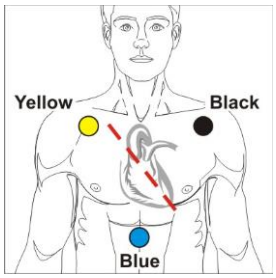
The EKG sensor requires the use of silver-silver chloride electrodes to make electrical contact between the skin and the sensor. In order to optimize the signal quality, a wide electrode placement is recommended, usually on the chest or on the forearms, so the electrodes should be indirectly connected to the sensor via an extender cable. To further enhance the signal quality, we recommend using pre-gelled electrodes like Thought Technology's UniGel electrodes (T3425M). Dry single strip electrodes can be used but Triode electrodes (T3402M) should be avoided because the triangular configuration is not appropriate for detecting EKG.

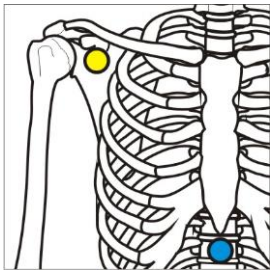
### *Enhancing electrode contact*


For optimal contact between the electrode and the skin, it is recommended to use conductive gel. Pre-gelled electrodes (UniGel) are easiest but it is possible to apply a bit of conductive paste or gel to the center of the single strip electrodes (grey area only) before applying them to the skin. Make sure the electrodes are placed firmly on the skin and that there is good contact between the skin and the electrode.

### *Chest Placement*

The ideal electrode placement for detecting EKG is a triangular configuration on the chest where the yellow and blue electrodes are parallel with the heart's main axis (see illustration). The yellow and black electrodes should be placed over the right and left coracoid processes, respectively, and the blue electrode over the xiphoid process.

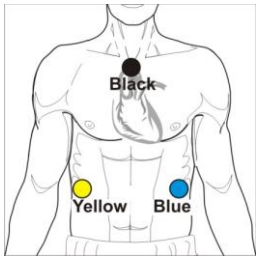


### *Abdominal Placement*

Since some clients may find the idea of exposing their chest area uncomfortable, an acceptable alternative is to place the electrodes on the abdomen.

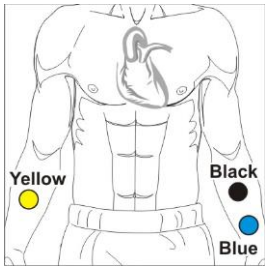
Ask the client to lift their shirt and place the yellow electrode below the ribs on the right and the blue electrode at the same level on the left. The black electrode can go anywhere, but a good location is the upper sternum area.




### *Arm Placement*

An easier electrode placement uses the forearms, as indicated in the illustration. The yellow electrode is on the right arm and the other two are on the left arm.

Ideally, an area with little or no hair is preferred. The arm placement is more susceptible to artifacts, particularly interference caused by arm and chest muscle activity.




### *Wrist placement*

The forearm electrode placement requires the use of an extender cable with longer leads like the one that is sold with the **EKG Wrist straps (SA9325)**. The wrist straps provide the easiest placement method for EKG signal detection. For best results, it is recommended to use BioGraph Infiniti's **Advanced IBI from EKG** beat detection algorithm when working with the Wrist Straps.

### EKG Receiver for Polar (P/N: SA9330)

The EKG Receiver detects the heart rate of a user from the Polar transmitter belt T31, T31c and WearLink®+ (**not provided**) that the user wears around the chest. The Wireless reception range of the EKG receiver is deliberately kept short, typically 80cm (2.5 feet) to prevent it from connecting with other belts in the neighborhood of the user.

***Note:*** *For the Heart Rate > 140 beats/min, the use of the BVP algorithm is recommended.*

#### Handling the EKG Receiver

Use the supplied sensor cable to connect the EKG Receiver (SA9330) unit to an encoder input (ProComp2, ProComp5, ProComp Infiniti or FlexComp Infiniti).

Use the supplied clip to attach the sensor to the user's shirt or belt.

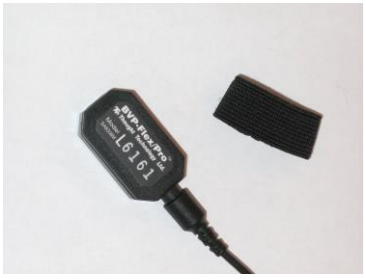
## BLOOD VOLUME PULSE (BVP): HR/BVP Sensor (P/N: SA9308M)

The HR/BVP sensor is a blood volume pulse (BVP) detection sensor (also known as a photoplethysmography – PPG – sensor) housed in a small finger worn package, to measure heart rate (HR) and provide BVP amplitude, BVP waveform, HR and heart rate variability (HRV) feedback.

Although BVP signals can be sampled at 256 samples per second, it is generally recommended to use a higher sampling rate (2048) because this allows for a higher precision in the detection of heartbeats. The BVP sensor can both be used on channel B of the ProComp 2 but not on channels A, C or D. They can be used on all channels of the ProComp 5 Infiniti and ProComp Infiniti encoders but channels A and B are preferred because they allow a higher sampling rate. They can be used on all channels of the FlexComp Infiniti.

#### Using the BVP sensor

The BVP sensor does not require skin preparation as it is placed directly in contact with the skin. Place the sensor against the fleshy part of the first joint of any finger and hold it in position using the elastic strap.

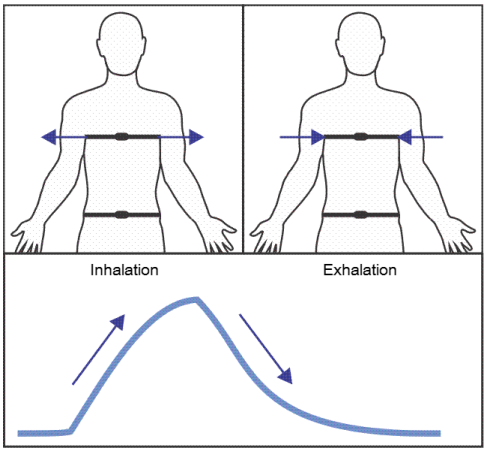


## RESPIRATION: Respiration Sensor (P/N: SA9311M)

The respiration sensor is a sensitive girth sensor worn using an easy fitting high durability woven elastic band fixed with a length adjustable webbing belt. It detects chest or abdominal expansion/contraction and outputs the respiration waveform.

The sensor is latex-free, magnet-free, and Velcro-free, and can be worn over clothing.

Since the respiration sensor can be used with any sampling rate, it can be connected to any input of any encoder (with the exception of channel A of the ProComp 2). Generally, however, it is connected to an input with a lower sampling rate.



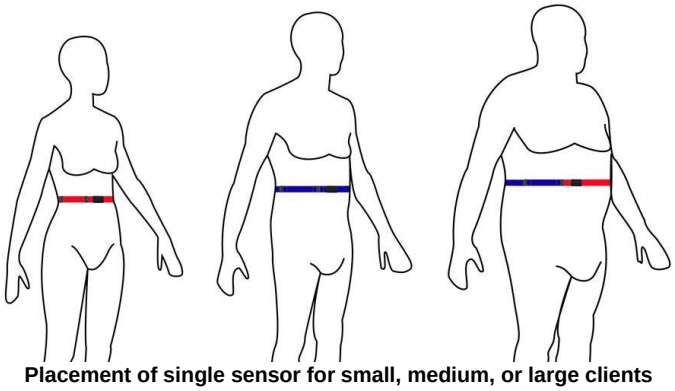

### Operating Principle

The respiration sensor is sensitive to stretch. When strapped around a client's chest or abdomen, it will convert the expansion and contraction of the rib cage or abdominal area, to a rise and fall of the signal on the screen. For the client's comfort, the elastic strap segment stretches when the abdomen expands during breathing.

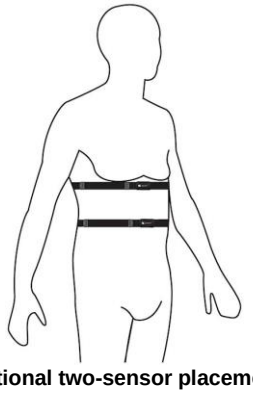
### Sensor Placement

For most applications, placing one sensor around the abdomen is required. Optionally, you can place a second respiration sensor around the chest. Using two sensors is helpful for abdominal breathing exercises.

The three straps (respiration sensor strap, elastic strap, and belt strap) are buckled together, and then placed around the client's torso.

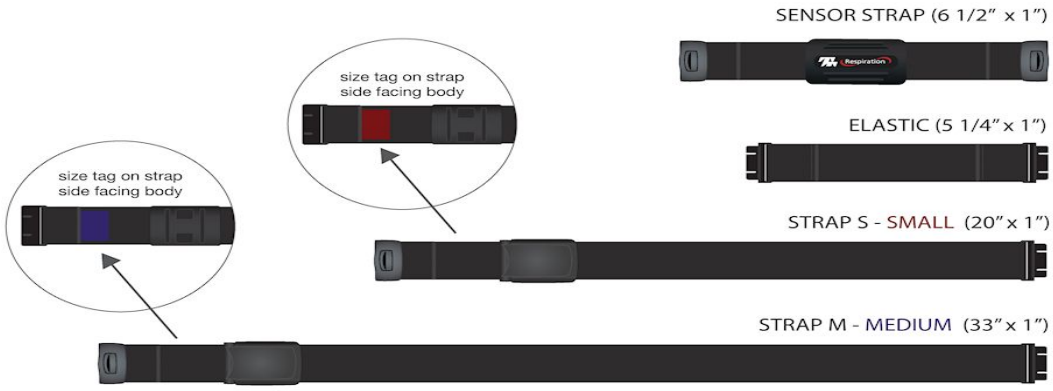


**Placement of single sensor for small, medium, or large clients**



**Optional two-sensor placement**

Select the appropriate belt strap length to fit the client. Belt straps come in small (red label) and medium (blue label) sizes. For clients who need a large or extra-large strap length, combine two belt straps.



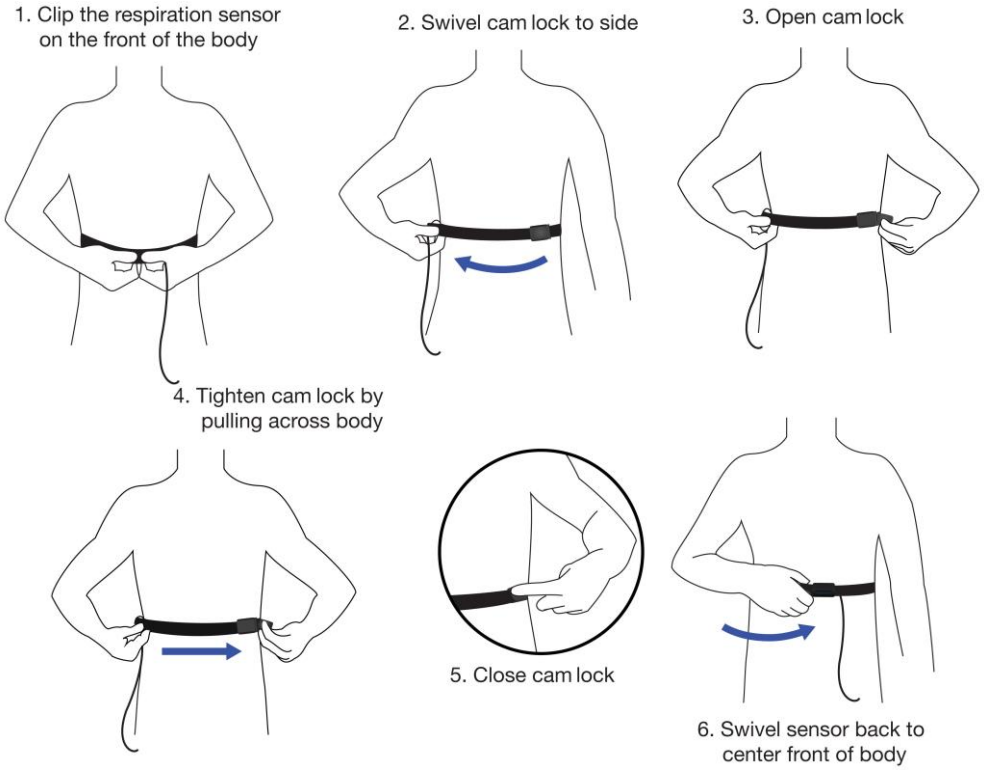

**Red labels correspond to small size, and blue labels correspond to medium size**

For especially petite clients the retention tab inside the cam lock of the small strap may be manually opened and the strap drawn through. Buckle the selected strap combination together and attach it around the abdomen so that the sensor is in the front.

**Cam lock**

Open the plastic cam lock and then slide it to adjust the strap tension. Ask the client to breathe out as fully as possible and close the cam lock to attach the sensor so there is minimal tension. The fit should be snug enough that the strap stays fixed when the client has fully exhaled.

There should also be enough slack in the elastic strap of the sensor so that expansion of the abdomen causes this strap to expand without being overextended.




**Care and Cleaning**

Hand wash the straps in lukewarm water with a mild soap, rinse them thoroughly, and hang them to air dry. The sensor unit can be wiped with a moist cloth.

***Warning***: *Do not immerse the sensor unit in water. Do not allow the sensor connector to get wet.*

## SKIN CONDUCTANCE: SC Sensor (P/N: SA9309M)

The Skin Conductance sensor measures the conductance across the skin, and is normally connected to the fingers or toes. Supplied with two finger bands.

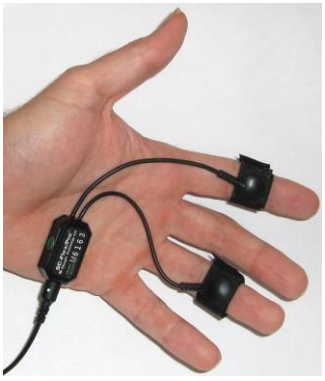
The standard measurement unit for conductance is called Siemens. Skin conductance is measured in micro-Siemens. Some biofeedback systems display skin conductance in micro-mhos (μm) - a mho is the inverse of an ohm, which is the measure of resistance. These two measures, μS and μm, are equivalent. Normal readings, for skin conductance, in a relaxed state are around 2 μS, but readings can vary greatly with environmental factors and skin type.

### Operating Principle

Skin conductance is a measure of the skin's ability to conduct electricity. A tiny electrical voltage is applied through two electrodes, usually strapped to two fingers of one hand, in order to establish an electric circuit where the client becomes a variable resistor. The real-time variation in conductance, which is the inverse of the resistance, is calculated. SC represents changes in the sympathetic nervous system. As a person becomes more or less stressed, the skin's conductance increases or decreases proportionally.

Skin conductance, galvanic skin response and electro-dermal response (EDR) are different terms for similar physiological measures.

### Sensor Placement



The skin conductance sensor has two short leads that extend from the circuit box. At the end of each lead is an electrode snap similar to those on the extender cables. The GSR sensor uses two replaceable electrodes that are sewn inside Velcro straps. The electrode strap must be fastened around a finger tightly enough so the electrode surface is in contact with the finger pad but not so tightly that it limits blood circulation. No conductive paste should be used on the electrodes. Remember to clean the electrodes with an alcohol wipe between clients. These AG/AG/CL electrode snaps should be replaced after about 50 uses or when wear is apparent.

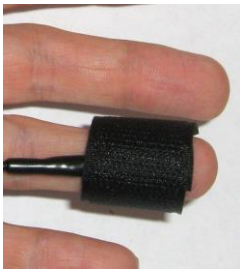
## PERIPHERAL TEMPERATURE: Skin Temperature Sensor (P/N: SA9310M)

The Temperature sensor measures skin surface temperature between 10°C – 45°C (50°F - 115°F). It is supplied with a self-adhering band for easy finger placement.

**Operating Principle**

The Skin temperature sensor is called a thermistor. This device converts changes in temperature to changes in an electrical signal. The body's peripheral temperature, as measured on its extremities, will vary according to the amount of blood perfusing the skin. This, in turn, is dependent on the client's state of sympathetic arousal. As a person gets stressed, their fingers tend to get colder. Relaxation training involves learning to voluntarily increase the finger temperature.

**Sensor Placement**



The temperature sensor can be strapped to the dorsal or palmar side of any finger or toe using the short strip of Velcro that is provided with the sensor. Remember to clean the thermistor bead with an alcohol wipe between clients.

## INFRARED TEMPERATURE EMISSION: pIR Sensor (P/N: SA2600)

The passive Infrared (pIR) sensor measures infrared temperature emission between 19.80°C – 40.21°C (67.64°F – 104.38°F). It is supplied as part of a set, along with a lightweight, ergonomic headgear for easy placement on the forehead.

**Operating Principle**

The pIR sensor is called an infrared receiver. This device converts changes in infrared temperature emission to changes in an electrical signal. The temperature that is emitted from the forehead is captured by the pIR sensor.

**Sensor Placement**

Two TT-pIR sensors are snapped on the inside of the TT-pIR Headgear device. The headgear is strapped gently to the head, holding the two sensors about 1.5 inches away from the skin, on each side of the midline of the forehead. The soft strap is adjusted so that the sensors sit firmly in place while maintaining maximum comfort.

# Accessories List

## Foot Pedal (P/N: SA7551)


The Foot Pedal connects to one of the encoder channels and allows the user to remotely drive the software (initiate the recording).

## Push Button Switch (P/N: SA7660)

Push button connects to one of the encoder channels and allows you to remotely set a time mark, move a script to the next step or respond to a stimulus.

## Voltage Isolator 4 Infiniti (P/N: SA9405MA)


The Voltage Isolator 4 Infiniti is an interface device which provides electrical isolation. It will allow Thought Technology's systems to be safely interfaced with analog outputs of line-powered systems, such as computers with DAC cards, isokinetic dynamometers, or force platforms.

It comes with different input ranges (set at factory on demand, when ordered): ±2.5V, ±5V, ±10V, 0 – 5V, 0 – 10V or 0 – 20V.

For more information, read the Voltage Isolator 4∞ manual.

## Tele-Infiniti CF™ (P/N: SA9600)


The Tele-Infiniti CF turns the encoder into a long range monitoring device. The unit disappears into the Compact Flash slot, leaving only the antenna visible to transmit data up to 300 feet (100 m).

For more information, read the Tele-Infiniti CF manual.

***Note:*** *Tele-Infiniti CF does not work with ProComp2.*

## TT AV-Sync™ (P/N: SA7670)


TT AV-Sync is a highly accurate time-synchronizing device for making measurements of audio and video events produced by a PC. AV Sync is used in evoked and slow cortical potential protocols, and reaction time testing to provide the ability to make measurements with millisecond accuracy.

It detects changes in light emitted from a LCD or CRT monitor as well as the presence of audio signal output. It produces highly accurate, time-locked trigger signals which can be read by software through the ProComp 5, ProComp Infiniti and FlexComp Infiniti encoders.

The device is connected to a PC which generates the audio and visual stimuli. For sound stimuli, the TT-AV Sync operates as a secondary sound device and plays the audio events generated by the PC.

For more information, read the TT AV-Sync manual.

# EEG Electrode Kits List

Thought Technology makes two types of EEG electrodes available in kit form.

- TT-EEG kits for use with Thought Technology's EEG-Z sensors.
- DC-EEG kits for use with Thought Technology's EEG-Z3 sensors.

## TT-EEG electrode kits

To prevent cross-infection and to prolong useful life of electrodes:

Rinse electrodes with lukewarm water and hang to dry. Disinfect by wiping with products such as Cidex®, Protex™, Sekusept® PLUS, and alcohol (70% isopropyl or 70% ethanol).

DO NOT SOAK! Soaking may damage electrodes.

### TT-EEG Monopolar / Bipolar Electrode Kit (P/N: T8750)

This kit contains the following components:

1 EEG Extender DIN cable (#SA8740)
1 TT-EEG gold cup cable – blue (# SA9323B)
1 TT-EEG gold cup cable – yellow (# SA9323Y)
1 TT-EEG gold ear clip – black (# SA9321)
1 TT-EEG gold ear clip – yellow (# SA9321Y)

### TT-EEG Monopolar / Bipolar Electrode Kit (without DIN cable) (P/N: T8751)

This kit contains the following components:

1 TT-EEG gold cup cable – blue (# SA9323B)
1 TT-EEG gold cup cable – yellow (# SA9323Y)
1 TT-EEG gold ear clip – black (# SA9321)
1 TT-EEG gold ear clip – yellow (# SA9321Y)

It is essentially the Monopolar / Bipolar Electrode Kit (T8750) without a DIN extender cable.

### TT-EEG Linked Ear Attachment Kit (P/N: T8755)

This kit contains the following components:

1 TT-EEG gold cup cable – black (# SA9323)
1 TT-EEG gold ear clip – yellow (# SA9321Y)
1 TT-EEG 2M1F Y-connector (# SA9319)

It is used with the Monopolar / Bipolar Electrode Kit (T8750) to include a linked ear reference.

### TT-EEG Two Channel Connectivity Kit (P/N: T8760)

This kit contains the following components:

1 TT-EEG gold cup cable – black (# SA9323)

2 1M2F Y-connectors (# SA9315)

1 2M1F Y-connector (# SA9319)

It is used with 2 Monopolar / Bipolar Electrode Kits (T8750) to permit the use of a single reference for 2 channels.

### TT-EEG Four Channel Connectivity Kit (P/N: T8761)

This kit contains the following components:

1 TT-EEG gold cup cable – black (# SA9323)

2 1M4F Y-connectors (# SA9315-4)

1 2M1F Y-connector (# SA9319)

It is used with 4 Monopolar / Bipolar Electrode Kits (T8750) to permit the use of a single reference for 4 channels.

## DC-EEG electrode kits

Sintered silver/silver-chloride (Ag/AgCl) electrodes are well-suited for DC measurements because they are less susceptible to electrode polarization (and DC drift) than other types of electrodes. Careful preparation and placement techniques should be used to further minimize these effects.

To prevent cross-infection and to prolong useful life of these electrodes:

Sintered Ag/AgCl electrodes must be carefully cleaned and maintained to reduce wear and prolong lifespan. When not in use, remove EEG paste and clean immediately.

To clean, rinse electrodes with lukewarm water and hang to dry. Disinfect by wiping with products such as Cidex®, Protex™, Sekusept® PLUS, and alcohol (70% isopropyl or 70% ethanol).

DO NOT SOAK! Soaking may damage electrodes.

### DC-EEG Three Disc Cable Electrode Kit (P/N: T8770)

This kit contains the following components:

1 DC-EEG Ag/AgCl electrode – blue (# SA7675B)

1 DC-EEG Ag/AgCl electrode – yellow (# SA7675Y)

1 DC-EEG Ag/AgCl electrode – black (# SA7675)

### DC-EEG Monopolar / Bipolar Electrode Kit (P/N: T8775)

This kit contains the following components:

1 DC-EEG Ag/AgCl electrode – blue (# SA7675B)

1 DC-EEG Ag/AgCl electrode – yellow (# SA7675Y)

1 DC-EEG Ag/AgCl ear clip– black (# SA9322)

1 DC-EEG Ag/AgCl ear clip– yellow (# SA9322Y)

### DC-EEG Linked Ear Attachment Kit (P/N: T8780)

This kit contains the following components:

1 DC-EEG Ag/AgCl electrode – black (# SA7675)

1 DC-EEG Ag/AgCl ear clip– yellow (# SA9322Y)

1 2M1F Y-connector (# SA9319)

It is used with the Monopolar / Bipolar Electrode Kit (T8775) to include a linked ear reference.

### DC-EEG Two Channel Connectivity Kit (P/N: T8785)

This kit contains the following components:

1 DC-EEG Ag/AgCl electrode – black (# SA7675)

2 1M2F Y-connectors (# SA9315)

1 2M1F Y-connector (# SA9319)

It is used with 2 Monopolar / Bipolar EEG Electrode Kits (T8775) to permit the use of a single reference for 2 channels.

# Cables List

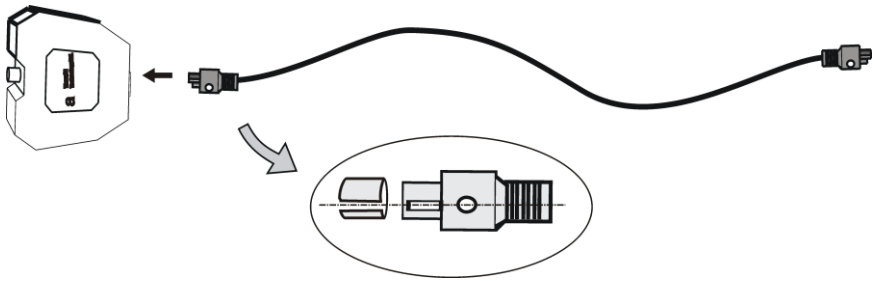
In the accompanying graphics, polarity is indicated as follows:

- Blue is Positive.
- Yellow is Negative.
- Black is Ground, or Reference.

## Replacement Cable (P/N: T9385M)

**Connect to sensor:**

Insert the replacement cable in the sensor head bottom, making sure to align the guiding dot on the cable connector with the groove on the sensor head.

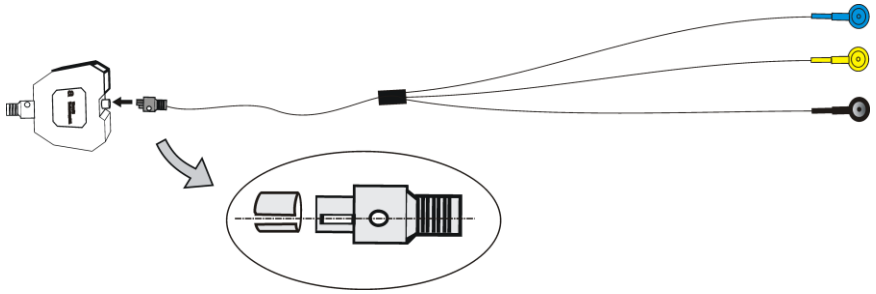


## EKG Sensor Extender Cable - 3 leads (P/N: T8710M)

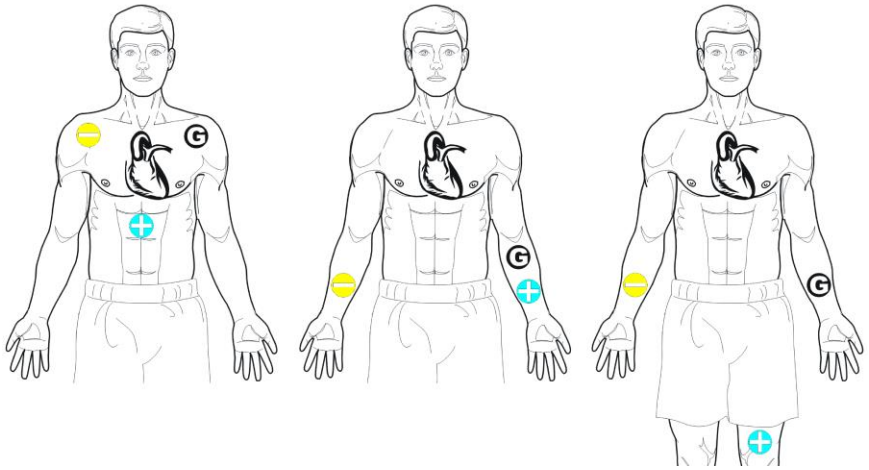
Use Thought Technology electrodes.

**Connect to sensor:**

Insert the extender cable in the sensor head, making sure to align the guiding dot on the cable connector with the groove on the sensor head.



**Placement:**

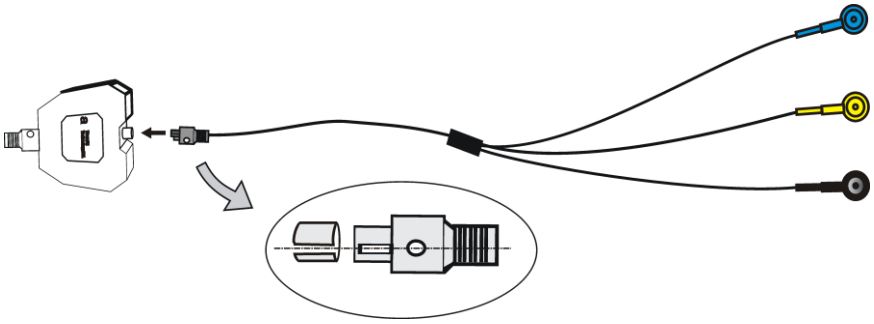


## Sensor Extender Cable - 3 leads (P/N: T8720M)

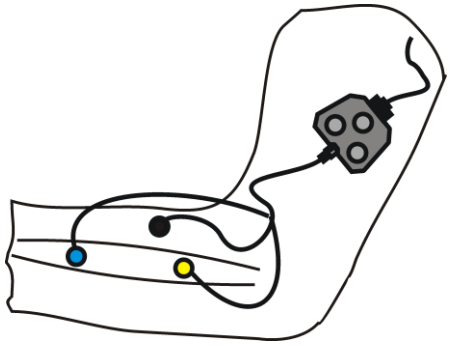
Use Thought Technology electrodes.

**Connect to sensor:**

Insert the extender cable in the sensor head, making sure to align the guiding dot on the cable connector with the groove on the sensor head.



**Placement:**



## Switch Sensor Cable (P/N: T9387M)

The switch sensor cable is a replacement cable designed specifically for use with the ProComp2 encoder and the EEG-Z sensor.

It enables you to trigger an impedance check by the EEG-Z sensor by pressing and releasing the switch button to briefly interrupt the sensor circuit.

The EEG-Z sensor enters impedance checking mode, without requiring you to disconnect and reconnect the sensor. This reduces wear and tear on the cable connection pins.

**Connect to sensor:**

Align the guiding dot on the top of the cable plug with the notch in the encoder input socket, and gently insert the plug into the socket.

Repeat this to connect the other end of the cable to the bottom of the sensor head.

# Hardware Specifications

## Sensors

### EEG-Z Sensor (SA9305Z)

| | |
|---|---|
| Size (approx.) | 37mm x 37mm x 12mm (1.45” x 1.45” x 0.45”) |
| Weight (approx.) | 25g (1oz) |
| Input impedance | 10GΩ in parallel with 10pF |
| Signal input range | 0 –200μV |
| Sensitivity | <0.1μVRMS |
| CMRR | >130dB |
| Channel bandwidth | 2Hz – 1kHz |
| Accuracy | ±0.3μVRMS, ±5% of reading @10°C to 40°C |

### EEG-Z3 Sensor (SA7680Z)


| | |
|---|---|
| Input impedance | Differential: 100GΩ paralleled with 270pF<br>Common-mode: 100GΩ paralleled with 200pF |
| Signal input range | 0 –200μV |
| Noise | < 0.5 μVRMS |
| CMRR (excluding CM signal active cancellation) | >100dB |
| CM active cancellation effect | > 40dB @10-120Hz |
| Accuracy | ≤ 1%, ±0.3μVRMS |
| Electrode offset tolerance (Slow AC and DC modes) | ±100mV |
| Bandwidth, lower cutoff, 3dB EP/.01Hz mode | 0.01 Hz |
| Bandwidth, lower cutoff, 3dB, EEG mode | 1.5 Hz |
| Bandwidth, upper 3dB (all modes) | 1600KHz |

### MyoScan/MyoScan-Z EMG Sensors (SA9503M/SA9503Z)

| | |
|---|---|
| Size (approx.) | 37mm x 37mm x 12mm (1.45” x 1.45” x 0.45”) |
| Weight | 15g (0.5 oz) |
| Input impedance | ≥10GΩ in parallel with 10pF |
| Input range | 0 – 2000μVRMS |
| Sensitivity | <0.1μVRMS |
| CMRR | >130dB |
| Channel bandwidth | 10Hz – 1kHz |
| Signal output range | 0 – 1.0VRMS |
| Input / output gain | 500 |
| Supply voltage | 7.26V (± 0.02V) |
| Current consumption | 0.7mA (± 0.25mA) |
| Accuracy | ±0.3μVRMS ±4% of reading @25°C to 30°C |

### MyoScan-Pro EMG Sensor (SA9401M-60 or SA9401M-50)

| | |
|---|---|
| Size (Approx.) | 37mm x 37mm x 15mm (1.45” x 1.45” x 0.60”) |
| Weight | 25g (1 oz) |
| Input Impedance | 1,000,000MΩ in parallel with 10pF |
| Input Range | 0 – 400μVRMS, 0 – 1600μVRMS |
| Sensitivity | <0.1μVRMS |
| Bandwidth | 20Hz – 500Hz |
| Accuracy | ±5%, ±0.3μVRMS |

### EKG Sensor (SA9306M)

| | |
|---|---|
| Length (approx.) | 152cm (60”) |
| Weight | 10g (0.33oz) |
| Temperature range | 10°C - 45°C (50°F – 115°F) |
| Accuracy | ±1.0°C (±1.8°F) 20°C – 40°C (68°F – 104°F) |

### EKG Receiver for Polar (SA9330)

| | |
|---|---|
| Dimensions | 25mm x 23mm x 11mm |
| Weight | 15g |
| Wireless Reception Range | 80cm (2.5 feet) typical, 105cm (3.5 feet) maximum |
| Output Waveform | Digital pulses 15mS |
| Operating temperature | 10ºC-40ºC |
| Current Consumption, maximum | 1.5mA |

### HR/BVP Flex/Pro Sensor (SA9308M)

| | |
|---|---|
| Length (approx.) | 20mm x 34mm x 10mm (0.72” x 1.33” x 0.41”) |
| Weight | 20g (0.66 oz) |
| Input range | Unit less quantity displayed as 0% – 100% |
| Accuracy | ±5% |

### Respiration Sensor (SA9311M)

| | |
|---|---|
| Size (with straps, approx.) | Small: 56 – 77cm (22 – 30.5”)<br>Medium: 72 – 111cm (28.5 – 43.5”)<br>Large: 102 – 161cm (40 – 63.5”)<br>Extra Large: 116 – 194cm (46.5 – 76.5”) |
| Weight (approx.) | 40g (1.3oz) |
| Signal Input Range | 0 to 12cm travel / 0 to 18kg force |
| Signal Output Range | 2.386V – 3.318V |
| Supply Voltage | 7.26V ±0.05V |
| Current Consumption | 3.6mA ±1mA |

### Skin Conductance Flex/Pro Sensor (SA9309M)

| | |
|---|---|
| Size without electrode leads (approx.) | 3.5 cm (1.4”) |
| Size with electrode leads (approx.) | 15 cm (6.0”) |
| Cable length (approx.) | 127 cm (50”) |
| Weight (approx.) | 25 g (1 oz) |
| Signal input range | 0 – 30.0 μS |
| Accuracy | ±5% and ±0.2 μS |

### Skin Temperature Sensor (SA9310M)

| | |
|---|---|
| Length (approx.) | 152cm (60”) |
| Weight | 10g (0.33oz) |
| Temperature range | 10°C - 45°C (50°F – 115°F) |
| Accuracy | ±1.0°C (±1.8°F) 20°C – 40°C (68°F – 104°F) |

### Passive InfraRed (pIR) Sensor (SA2600)

| | |
|---|---|
| Length (approx.) | 152cm (60”) |
| Size (approx.) | 368mm x 391mm x 145mm (1.45” x 1.54” x 0.57”) |
| Weight | 12.5g (0.44oz) |
| Temperature range | 19.80°C – 40.21°C (67.64°F – 104.38°F) |
| Absolute accuracy | ±0.5°C (±0.9°F) |
| Measurement resolution | 0.02°C (±0.036°F) |

## Accessories

### Tele-Infiniti CF (SA9600)


Bluetooth 2.0, Class 1
Protocol: Bluetooth 2.45GHz ISM band (2.400–2.500 GHz)
Maximum power output:12dBm (16mW)
Power Consumption: 160mW (with 10 channels connected)
Conforms to: IEC 60601-1-2, EN55011 Radiated Emissions, Class B, Group1 and FCC regulations (FCC ID P00WML-C40)

### Voltage Isolator 4∞ (SA9405MA)

| | |
|---|---|
| Dimensions | 5.7 x 3.6 x 1.2 in (14.5 x 9 x 3 cm) |
| Weight | 180g |
| Voltage Input Range | ±2.5V, ±5V, ±10V, 0 – 5V, 0 – 10V or 0 – 20V (factory setting) |
| Isolation Voltage | 4500 Vrms |
| Input Impedance | ±2.5V, 0 – 5V: 50kΩ |
| Voltage Input Bandwidth | 0 – 1kHz |
| Accuracy | ∆Gain < ±1% Offset <1mV (bipolar), <5mV (unipolar) |
| Noise | <100µV RMS |
| Voltage Output | 2.8V ± 1.5V |
| Frequency Response | 0 – 1 KHz |
| Temperature range (operating) | 10 - 40 ˚C |
| Crosstalk | < -90dB or better |
| Power supply | 9V Alkaline battery (6LR61) or 9VDC power adapter |

## TT AV-Sync (SA7670)


| | |
|---|---|
| Audio detection accuracy (silence-to-sound transition) | <200μs |
| Audio detection recovery (sound-to-silence transition) | <200ms<br>Not intended for sound to silence detection. |
| Audio headphone impedance | 16Ω, single headphone<br>8Ω, dual headphones |
| Visual trigger delay time (black to white) | <200μs |
| Visual trigger recovery time (white to black) | <150ms<br>Not intended for white to black detection. |
| Isolation (PC side to encoder side) | 4kV VAC(rms) |

# Placing Orders

Outside USA

Tel: 1-514-489-8251

Fax: 1-514-489-8255

In USA Toll-Free

Tel:1-800-361-3651

E-Mail: mail@thoughttechnology.com

Or contact your local authorized distributor.

# Technical Support

Outside USA

Tel: 1-514-489-8251

Fax: 1-514-489-8255

In USA Toll-Free

Tel: 1-800-361-3651

E-Mail: techsupport@thoughttechnology.com

Or contact your local authorized distributor.

# Warranty

Sensors and accessories are guaranteed to be free from defects in material and workmanship for 1 year from the date of purchase.

In the unlikely event that repair is necessary, contact Thought Technology Ltd. to receive a Return Authorization number. Then send the unit back by a traceable method. Thought Technology will not be responsible for items not received. We will repair or replace your unit(s) that are still under warranty free of charge.

This warranty does not apply to damage incurred through accident, alteration, or abuse.

This warranty does not cover damage to the Infiniti encoder caused by obvious mechanical mistreatment of the system.

# Returning Equipment

Before returning the equipment, please contact first our service department and get an authorization number (RA number).

**Canada and International +1 514 489-8251**

**USA 1-800-361- 3651**

**service@thoughttechnology.com**

Then fill-in the return form (the form can be found at the end of the manual). You must provide a detailed description of the problem you are experiencing, and your telephone/fax number and e-mail.

The unit(s) must be sent **postage prepaid** and **insured**, with proof of purchase to one of the addresses below.

All customs and duties charges will be billed to the customer if incurred by sending the unit to the **wrong** address.

**In the USA**, ship insured to:

Thought Technology Ltd.
Cimetra LLC
8396 State Route 9
West Chazy, New York
12992 USA

**In Canada**, ship insured to:

Thought Technology Ltd.
5250 Ferrier, Suite 812,
Montreal, Quebec,
Canada H4P 1L3

**For international:**

- Package must be marked with “Broker: Livingston International – 133461”

- Ship insured to:

Thought Technology Ltd.
5250 Ferrier, Suite 812,
Montreal, Quebec,
Canada H4P 1L3

# Repair Return Form

**Be sure to contact us for authorization before returning any equipment!**

Remove this sheet and include with returned unit(s).

Include copy of original invoice and return to the address in the Returning Equipment section.

**Name** _____

**Company** _____

**Address** _____

_____

_____

**Phone No.** _____

**Fax No.** _____

**Date Purchased** _____

**From Whom** _____

**Model Name** _____

**Serial Number** _____

_____

_____

**Problem** _____

_____

_____

_____

_____

_____

_____